

DESIGN AND CHARACTERIZATION OF A NOVEL THREE DIMENSIONAL WOVEN-KNIT HYBRID FIBROUS PREFORM FOR COMPOSITE REINFORCEMENT

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The novel three-dimensional hybrid weaving/knitting machines is optimized and automated. Fine tuning of the machine functions was done including needle movement, yarn release, yarn feeding, and beat-up. Figure 1 shows the current state of the machine.

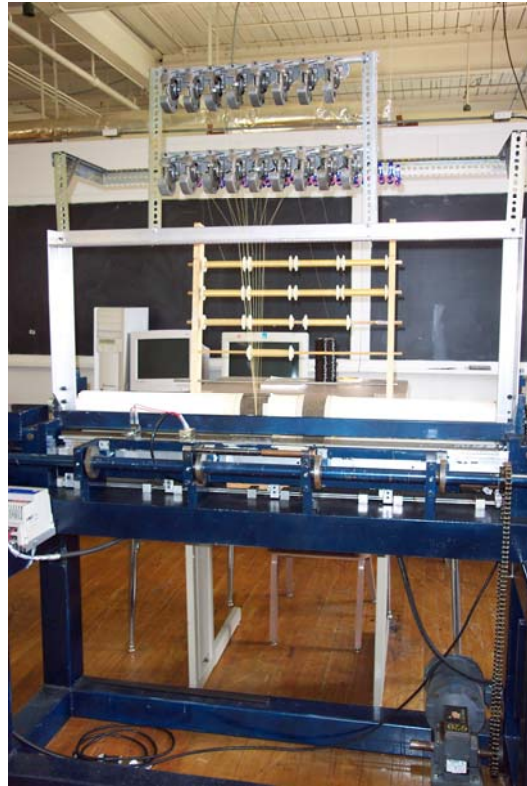


Figure 1. 3D hybrid weaving/knitting machine after the last modifications

After these modifications, more samples of novel 3D fabric structures were produced on the machine. Figure 2 shows some of the samples produced. The warp yarn is polypropylene, 4 ply, each ply is continuous with a denier of 2565. The filling (stitch) yarn is Kevlar® aramid, with a denier of 315.



Figure 2. Examples of 3D hybrid woven/knit preforms produced

For comparison purposes, composites from woven carbon fabrics (3/1 twill) were also produced (Figure 3). In addition, these preforms were stitched to prevent delamination. The thickness of these samples correspond to the thickness of the novel 3D samples. Durkopp-Adler industrial stitching machine was used for stitching.

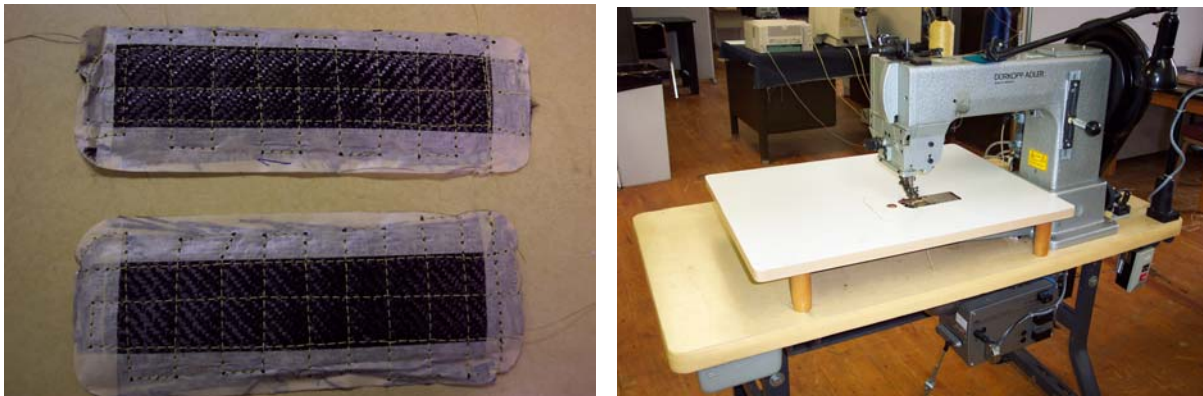


Figure 3 Stitched carbon fabrics for composite reinforcement (left) and stitching machine used

Composite samples were produced using the vacuum bag technique (Figure 4). The resin used was XK105-1 vinyl ester resin from AOC, Collierville, TN. Novel 3D and stitched samples were cut to the specified dimensions for 3 point bending tests according to the ASTM standards (Figure 5).



Figure 4 Manufacturing of composites



Figure 5 Preparation of samples for 3 point bending tests

The samples were tested for 3 point bending using the Instron 4505 machine (Figure 6). Figure 7 shows a typical test result.



Figure 6 Instron 4505 machine

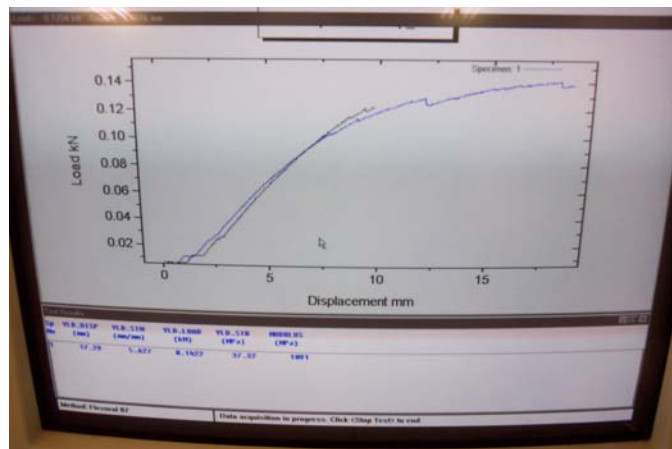
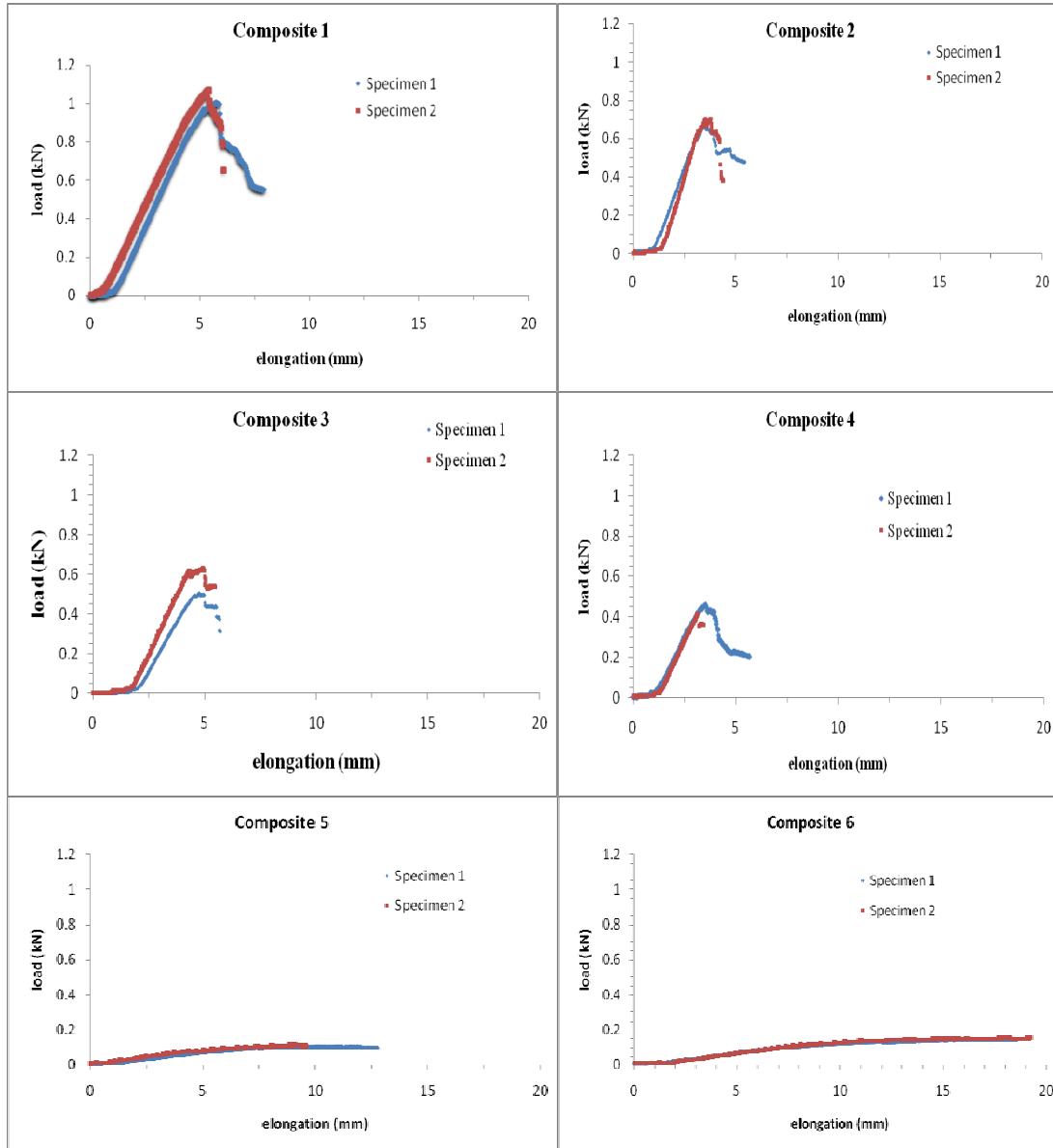


Figure 7 Three point bending test result

RESEARCH FINDINGS

The following charts show the results of the three point bending tests. These results are being analyzed to be included in the paper under preparation.



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